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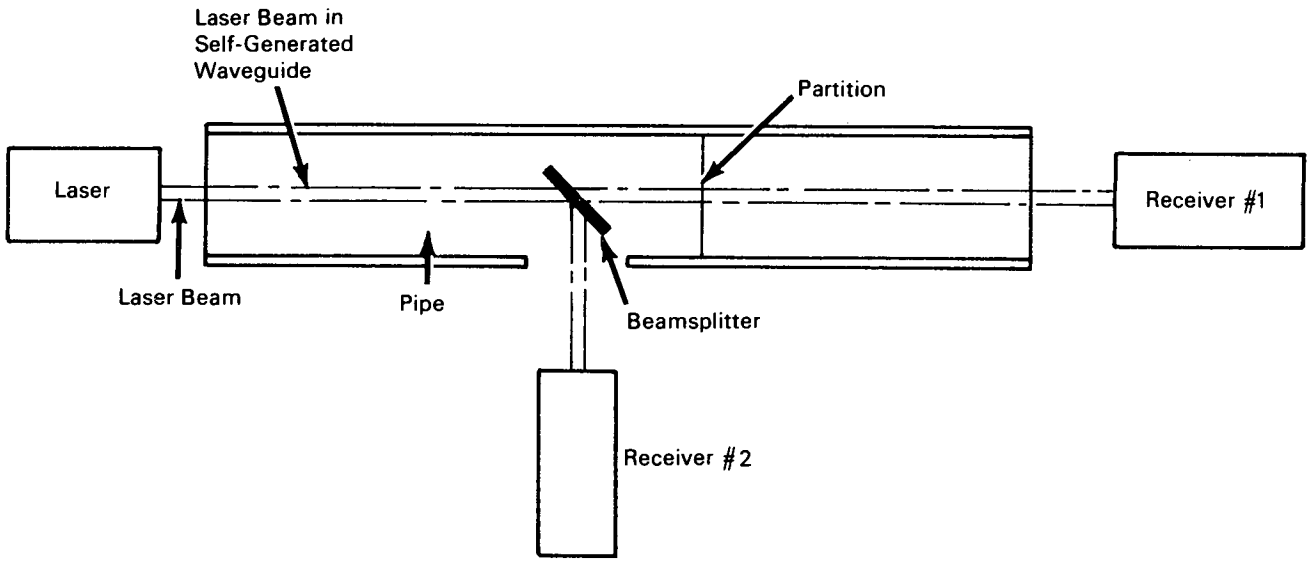
Optical Frequency Waveguide and Ion Transmission System



Optical Frequency Waveguide

A self-generating, optical frequency waveguide is proposed for improved communications, fashioning of materials, and surgical operations. The basis of the invention is diffractionless transmission of electromagnetic radiation by formation of a dielectric waveguide between the source and receiver.

An electromagnetic beam of optical frequency of sufficient power and correct diameter can produce its own dielectric waveguide and is capable of propagation through a dielectric medium with minimum refraction loss due to its ability to confine its rays of energy. This occurs in materials in which the dielectric content increases with field intensity and is homogeneous in the absence of electromagnetic radiation.

In these materials, a high-energy electromagnetic beam can produce a tube of material with a higher dielectric constant in a shape and diameter corresponding to the beam. Divergent rays within the beam will be internally reflected at the edge of this tube (at the transition point from high to low dielectric constant). Thus, this self-generated, high-dielectric tube forms a waveguide which retains the electromagnetic energy within the beam.

The trapped beam establishes a waveguide of appropriate characteristics for its own conduction; weak waves of higher frequency are conducted but not those of lower frequency. To a first-order approximation, the dielectric properties of the waveguide are undis-

(continued overleaf)

turbed by such a wave, provided that the beat frequency between it and the initial wave is too high for the dielectric to respond.

Power density of the beam and critical power for self-trapping are distinctly different and separable. Critical power can be preselected relative to wavelength, beam diameter, etc., according to the required function of the beam. Thus for cutting or forming operations high power densities are required, while for long-range transmission, low-level power density should be maintained to minimize losses due to heating. A steel pipe filled with carbon dioxide is recommended as the basic structure, because the gas has a favorable index of refraction. However, the critical power for beam-entrapment is a function of gas pressure. The power required for the self-trapping at one atmosphere pressure is one hundred times greater than the power required at one hundred atmospheres. Thus the pressure used to fill the pipe should be modified to suit particular applications, depending upon the power of the beam to be used.

Note:

No additional documentation is available. Specific questions, however, may be referred to:

Technology Utilization Officer
Headquarters
National Aeronautics
and Space Administration
Washington, D.C. 20546
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Patent status:

Inquiries about obtaining rights for the commercial use of this invention may be made to NASA, Code GP, Washington, D.C. 20546.

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